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The Asthma Insights and Reality in the Maghreb (AIRMAG) study: perspectives and lessons

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Summary

Asthma is the most frequently encountered allergic respiratory disease, and one that has a potentially serious impact on patients' functioning and well-being. From a public health perspective, it is important to collect data on the prevalence, burden and management of asthma in order to improve understanding of the pathogenesis of asthma and to ensure that national healthcare policies are adapted and appropriate. In this respect, the different AIR surveys, which have collected standardised data on asthma in the general population of a large number of countries around the world, have made an important contribution. The latest of these surveys is the AIRMAG survey, performed in the three Maghreb countries of Algeria, Morocco and Tunisia. In these countries, the prevalence of asthma (3.4% to 3.9%) is in the low to moderate range. This is consistent with rates observed elsewhere in the Mediterranean basin. Nonetheless, the prevalence of asthma in the Maghreb may be expected to rise in the future as populations become more urbanised and adopt a more 'Westernised' lifestyle. Indeed the prevalence of asthma is already higher in the urban coastal regions of these countries than in the more rural mountainous and desert regions. Asthma control in the Maghreb is relatively poor compared to other regions evaluated in previous AIR studies, with control being unacceptable in around three-quarters of respondents. Although part of the explanation may reside in limited access to care, treatment rates for inhaled corticosteroids (26.1% of adults and 29.1% of children) were no worse than those reported in previous AIR studies. On the other hand, asthma monitoring through regular follow-up visits, home flow-meter use and preparation of individualised asthma management plans was in general unsatisfactory. In addition, awareness of asthma in the general population of the Maghreb countries was low. Education measures directed at the patient, together with programmes directed at the physician to ensure systematic monitoring and the use of a 'treat to target' approach to therapy, could do much to increase quality of life and minimise restrictions on activities in patients with asthma in the Maghreb.

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Asthma is a chronic respiratory disease affecting around 300 million people worldwide, and this number is rising due to demographic growth and to lifestyle changes¹. Although asthma affects individuals in all countries, of all ages and of all ethnic groups, prevalence rates for clinical asthma (which have been reported to vary from around 1% in Indonesia to around 18% in Scotland¹), management

paradigms, the severity and control of asthma may differ markedly between countries.

In order to understand these geographical differences, and to help adapt public health policies for asthma management to local needs, information on asthma needs to be collected in a standardised way worldwide. A number of multinational epidemiological studies have been performed with the aim of comparing the burden of asthma between countries. Two of these, both performed in the early nineties, have been particularly informative due to their extensive geographical coverage and the large numbers of individuals included. These are the European

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Table 1. Regional and national surveys using the AIR methodology

Survey	Region	Year	Participating countries	N	
				Households	Asthma
AIA ^{14,15}	North America	1998	United States	42,022	2,509
AIRC ¹⁶	North America	1999	Canada	49,767	1,001
AIRE ¹⁷	Europe	1999	France, Germany, Italy, The Netherlands, Spain, Sweden, UK	73,880	2,803
AIRIAP ¹⁸	Asia-Pacific	2000	China, Hong Kong, Korea, Malaysia, Philippines, Singapore, Taiwan, Vietnam	108,360	3,207
AIRJ [19–21]	Asia-Pacific	2000, 2005	Japan	38,132 ^a	803 ^a
AIRCEE ¹⁹	Eastern Europe	2001	Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine	NA ^b	1,617
AIRLA ²⁰	Latin America	2003	Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Paraguay, Peru, Uruguay, Venezuela	46,275	2,184
AMOA ²¹	Australasia	2003	Australia	42,837	1,205
AIRET ²²	Middle East	NA	Turkey	8,350	400
AIRGNE ²³	Middle East	2007	Jordan, Kuwait, Lebanon, Oman, United Arab Emirates	QM ^c	1000
AIRSA ²⁴	Middle East	2007	Saudi-Arabia	QM ^c	700
AIRNZ ^d	Australasia	NA	New Zealand	NA	NA
AIRMAG	North Africa	2008	Algeria, Morocco, Tunisia	46,989	872

^a These figures correspond to the first (2000) AIRJ survey.

^b No information on the number of households contacted is available for the AIRCEE survey, nor on the prevalence rates observed.

^c The AIRGNE and AIRSA surveys used a quota method with a target number of individuals with asthma to recruit. This selection method precluded the determination of asthma prevalence in these two studies.

^d No published data is available for the AIRNZ survey.

Community Respiratory Health Survey (ECRHS)², which addressed asthma in young adults (20–44 years old), and the International Survey of Asthma and Allergy in Children (ISAAC)^{3,4}, which investigated paediatric asthma.

The ECRHS was funded by the European Commission and initiated in 1990. It evaluated prevalence of asthma symptoms, risk factors, airway responsiveness and use of health services in interviewees from selected regions of seventeen European countries, later extended to five non-European countries (Algeria, Australia, India, New Zealand and the USA). The prevalence of asthma symptoms was found to be generally lower in Mediterranean countries than in the British Isles, New Zealand, Australia and the United States. In the ISAAC study, schoolchildren in two discrete age groups (6–7 year-olds and 13–14 year-olds) in specified geographical areas were asked about asthma using a written and video questionnaire. Fifty-six countries from all continents participated and provided the first world map of the prevalence of paediatric asthma. Again, striking regional differences in the prevalence of asthma symptoms were noted, the prevalence of wheezing, for example, being less than five percent in most Asian countries and over thirty percent in the United Kingdom were noted. However, both these surveys present certain limitations. These relate to the restricted age groups considered, and the geographical areas of each country investigated, which were not randomly selected and generated a number of unanticipated within-country disparities in prevalence.

There is also information suggesting that the prevalence of asthma may be increasing over time^{5,6}. This has come from several national studies comparing the prevalence of asthma in the same target population at two different time points, for example surveys performed in the USA⁷, Australia⁸ the Netherlands⁹ and Scotland¹⁰. Similarly, a reiteration of the ISAAC study, conducted in 2002–2003 in many of the same centres as the original survey, reported rises in the prevalence of asthma in many countries

studied¹¹. In the ECRHS survey a strong association was seen between birth cohort and incidence of asthma, this being higher in individuals born later on¹². However, a reiteration of the ECRHS¹³, in which the same patients from the first survey were interviewed again in 1998–2003, showed no increase in the prevalence of symptoms, although the proportion of interviewees reporting having received a diagnosis of asthma had increased.

The Global Initiative for Asthma (GINA) was established in 1993 by the World Health Organization with the goals of, *inter alia*, increasing awareness of asthma and its public health consequences, and of improving the management of asthma and the availability and accessibility of effective asthma therapies. Since that time, GINA has played an important role in collecting, collating and making available data on asthma collected around the world and in providing guidelines for optimising the management of asthma by physicians.

Subsequently, the Asthma Insights and Reality (AIR) programme has been initiated with the aim of collecting epidemiological data on asthma control and management from the patient's perspective, and of determining to what extent the treatment goals of the GINA guidelines are being met. This programme was initiated and funded by GlaxoSmithKline laboratories, who have a longstanding involvement in the treatment of asthma.

The AIR surveys

The AIR surveys use a standardised, computer-assisted telephone interview method to collect data on asthma from a randomly selected sample of the general population, and thus should generate a reliable national prevalence estimate for asthma. As well as collecting data on prevalence and severity of asthma, the AIR surveys also investigate asthma control, the burden of asthma, the management and treatment, and the perceptions and

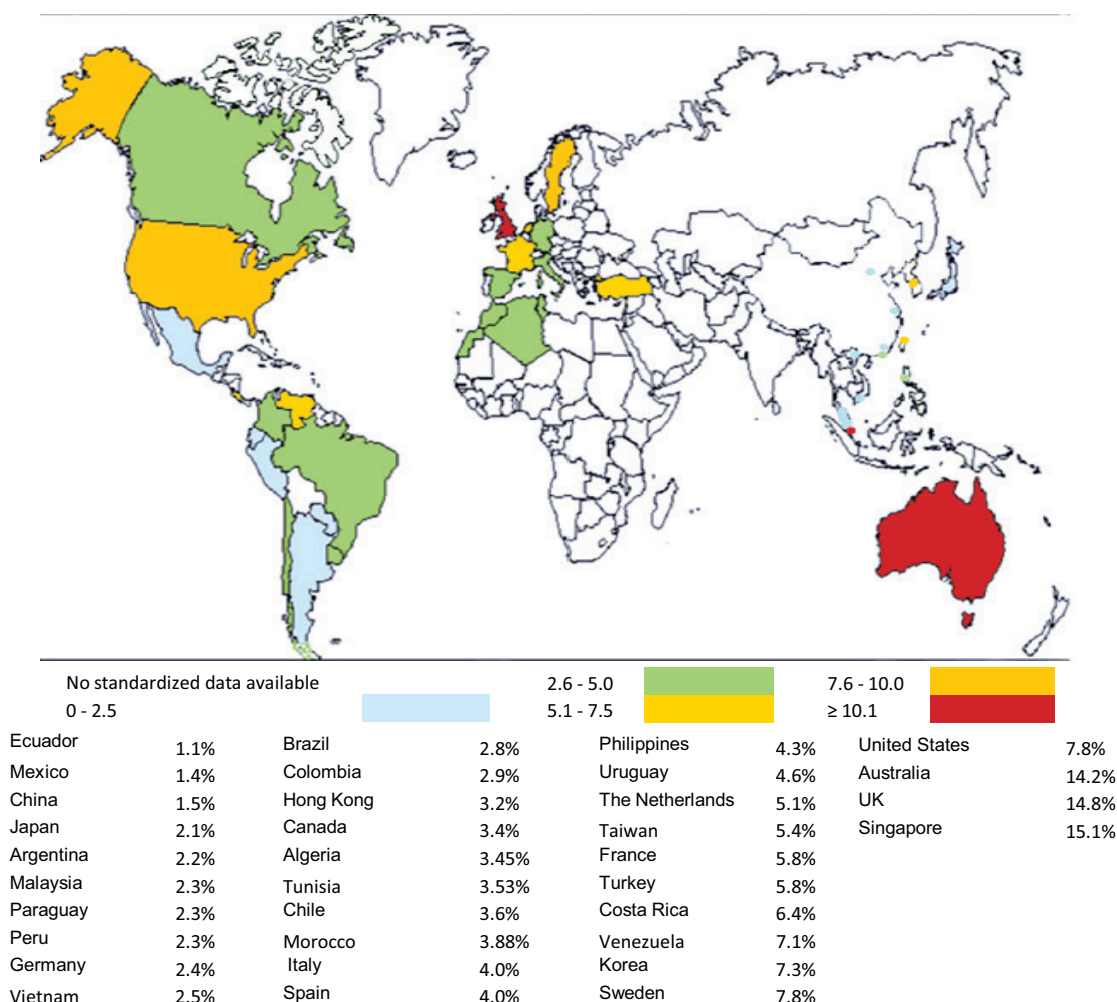


Fig. 1. Prevalence rates reported in the different AIR surveys. For most surveys, a nationwide population was evaluated. In the AIRAP survey (Asia-Pacific), only metropolitan centres were considered. These are indicated on the map as coloured spots. In the AIRLA (Latin America) and AIRET (Turkey), only urban centres were considered, but these are not specified in the source publications. Prevalence data are not available for the AIRCEE, AIRGNE, AIRSA and AIRNZ surveys.

understanding of asthma. The AIR surveys have now been performed in eight regions of the world, starting with North America in 1998, and have collectively interviewed nearly half a million people (Table 1). The most recent contribution to the AIR programme has come from the AIRMAG survey, performed in three Maghreb countries (Algeria, Morocco and Tunisia). The findings of the AIRMAG survey are described in detail in this supplement.

Asthma prevalence

The data collected in the various AIR surveys have revealed major differences in asthma prevalence rates between countries (Fig. 1). These geographical differences are broadly consistent with those reported for children in the earlier ISAAC surveys. The prevalence rates estimated for the Maghreb countries (3.4% in Algeria, 3.5% in Tunisia and 3.9% in Morocco) are higher than those reported in most Latin American countries, most Asian countries, Japan and Germany, but lower than those reported for the Philippines, Uruguay, most Western European countries, Taiwan, Turkey, Costa Rica, Venezuela, Korea, the United States, and above all, Australia and Singapore. The prevalence of asthma was

somewhat higher in children than in adults, as in the other AIR surveys, although this difference was not major (crude prevalence in adults: 3.5; in children: 4.0%).

The prevalence rates observed in the AIRMAG survey²⁵ can perhaps best be compared with those from AIRET in Turkey²², with which the Maghreb countries share a common Mediterranean lifestyle and Islamic culture. Given that the AIRET study was only carried out in urban centres, the prevalence rates observed are quite similar. It should nonetheless be pointed out that, paradoxically, the recent PARFAIT study of allergic diseases in Turkey²⁶ reported that the prevalence of childhood asthma was higher in rural than in urban centres, a finding that is inconsistent with the results of the AIRMAG study²⁵ and numerous other studies performed elsewhere in Africa²⁷ and other developing countries²⁸.

The fifteen-fold variation in the prevalence of asthma between different regions of the world observed in the AIR studies is largely consistent with the findings of the ISAAC study a decade previously⁴. It is interesting to speculate why such differences may arise. As a general rule, prevalence seems to be relatively high in the British Isles,

North America and Australasia and relatively low in most developing countries. Although genetic differences cannot be excluded, as suggested by the important hereditary component to asthma, the genetics of asthma are complex and poorly understood^{29,30}. It seems unlikely that any single gene plays a major role in the predisposition for asthma, and multiple genetic factors may influence susceptibility to environmental risk factors for asthma rather than playing a direct role in pathogenesis. In the second National Health and Nutrition Examination Survey (NHANES II) performed in the USA, the prevalence of asthma was significantly higher in individuals of Caucasian origin (9.2%) compared to Afro-Americans (6.9%)³¹, although this difference could be explained by socioeconomic factors as well as by ethnicity. Indeed, such a difference was no longer observed ten years later at the time of the third NHANES survey³². A preponderant influence of environmental factors thus seems likely, which has been suggested by a number of studies investigating immigrant communities. For example, a study of Turkish children in Germany³³ showed that a higher degree of cultural adaptation was associated with a higher prevalence of atopy and asthma. Data from the ECRHS study indicate that migrants generally acquire the asthma prevalence status of their host countries³⁴. Similarly, in the NHANES III study in the USA, the prevalence of asthma was higher in Mexican-Americans born and raised in the USA than in immigrants from Mexico³⁵. An adoption study in Sweden³⁶ has shown that the earlier children adopted from developing countries arrived in Sweden, the more likely they were to develop asthma. On the other hand, another study by the same group³⁷ revealed that children born in Sweden to immigrants retain a similar relative risk of developing asthma to their parents, suggesting that ethnicity plays some role.

Generally speaking, it appears that countries and populations with a higher standard of living, that are more urbanised, and have a more 'westernised' lifestyle present higher prevalence rates for asthma. A striking example of this comes from a series of studies in Germany, where asthma prevalence in the former East Germany, which was previously half that in West Germany³⁸, has risen to Western rates in children born since reunification³⁹. In the ISAAC study, a strong correlation was observed between the prevalence of asthma attributable to atopy (but not non-atopic asthma) and national *per capita* income⁴⁰. On the other hand, within countries, high asthma risk is associated with low economic status, for example as observed in the NHANES III survey³² and more recently in the Portugal Health Survey⁴¹, and with poor housing conditions⁴².

Various factors have been suggested to explain these findings, including exposure to an agricultural environment, which may offer protection against developing asthma, exposure to airborne or industrial pollutants, which would increase risk, and dietary factors^{27,28,43}. A number of studies, including the ECRHS, have shown that children growing up on farms have a lower risk of asthma than others^{44–46}. For example, in the ALEX study, it has been postulated that allergens encountered in early life may inhibit polarisation of helper T cell development towards a Th2 phenotype^{47,48}, which is thought to underlie atopic sensitisation⁴⁹. In addition, a study in France reported a lower prevalence of asthma in children living in a

mountainous area, related to lower exposure to house dust mite allergens with altitude⁵⁰. The AIRMAG study, which demonstrated two- to three-fold differences in prevalence between rural and urban regions of the Maghreb²⁵ is consistent with such observations. Although air pollution is clearly detrimental to respiratory function, it is unlikely that this can explain the regional differences in asthma prevalence, since studies from Germany³⁸ and China⁴³ have indicated that asthma is less frequent in highly polluted industrial areas than in wealthier regions with an economy based on the tertiary sector. Similarly, smoking rates, and thus exposure to tobacco smoke, is high in many developing countries, including Tunisia in the Maghreb, although asthma prevalence rates are low. It thus seems that any deleterious effect of airborne pollution is overridden by a protective effect of a less 'Westernised' society.

It is also possible that tuberculosis or other respiratory infections that are relatively frequent in the Maghreb confer some degree of protection against asthma. For example, in the ISAAC survey, tuberculosis notification rates between participating countries were negatively associated with asthma prevalence rates⁵¹. According to recent WHO data⁵², the incidence of tuberculosis in the Maghreb countries range from 25 cases in Tunisia to 93 cases in Morocco per 100,000 individuals per year, compared to incidence rates of less than twenty in most Western European countries, North America and Japan⁵². In addition, a number of studies have shown neonatal anti-tubercular BCG vaccination to be associated with a reduced risk of subsequent development of asthma in children^{53–55}. Moreover, a Korean study showed that BCG vaccination in active asthma patients led to an amelioration in symptoms⁵⁶, perhaps through modification of the Th1/Th2 balance in the T helper cell population. In contrast, infections with certain viruses that target the respiratory tract, such as respiratory syncytial virus, influenza virus and rhinovirus, as well as bacterial infections with *Mycoplasma pneumoniae* and *Chlamydia pneumoniae*, may increase the risk of developing asthma or predispose to exacerbations^{57,58}. It is possible that differences in the occurrence of these infections between regions may contribute to the variation in asthma prevalence observed worldwide.

Finally, diet has been suggested to contribute to regional differences in asthma prevalence, and also to the increase in prevalence observed over time in many countries^{59–61}. In the ISAAC cohort, an inverse relationship between national fruit and vegetable consumption patterns and asthma prevalence has been described⁶², and a number of studies have suggested a protective effect of a 'Mediterranean' diet against the development of asthma and other atopic diseases⁶³. In this respect, the patterns of asthma prevalence observed in the different AIR studies would be consistent with this hypothesis, with relatively low prevalence rates (<5%) being observed in all the Maghreb countries²⁵, as well as in Italy and Spain¹⁷. An association between asthma and obesity has been observed in many countries and it has been suggested that excessive weight is a risk factor for the development of asthma⁶⁴.

Although historically low, as elsewhere in the Arab-speaking world, the prevalence of obesity in the Maghreb countries has risen dramatically over the last two

decades⁶⁵, due to increased sedenterisation and changes in diet, and now is approaching prevalence rates seen in industrialised countries. It may thus be anticipated that the increases in obesity and generally increasingly 'westernised' life style occurring in the Maghreb may bring with it a rise in the prevalence of asthma, and it will be important to follow any emerging trends carefully so that public health policies can be adapted accordingly. The data collected in the AIRMAG survey reported in this supplement will serve as an important reference source to monitor any future changes in the prevalence of asthma in the Maghreb due to lifestyle changes or changes in the burden of disease brought about by the implementation of public health policies aimed at improving standards of care. In addition, the AIR methodology provides a sufficiently sensitive instrument to detect changes in the experience of asthma in general population samples, as witnessed by the two consecutive AIR studies performed in Japan in 2000 and 2005^{66,67}.

Asthma control

A number of the AIR studies, particularly the earlier ones, evaluated the severity of asthma according to a classification proposed by GINA in its earlier releases on the basis of the frequency of nocturnal and diurnal symptoms, of exercise-induced symptoms and of severe asthma episodes. However, this evaluation does not take into account any treatment the patient may be taking, which may confound the evaluation in the case of effective treatment control. In the majority of these studies, the distribution of severity grades was rather similar, with around half of the subjects being classified as intermittent and around 20% as severe persistent. The two exceptions to this rule are the AIRCEE study in Central and Eastern Europe and the AIRMAG study (Table 2), in which the severity distribution of the samples was shifted towards higher severity. The reason for this difference is not clear, since an identical questionnaire was used in all studies.

However, these data on severity are difficult to interpret, particularly in an age in which most patients whose underlying disease is severe are, or should be, receiving an appropriate treatment. Thus, an individual could be classed in the 'intermittent' category either because the underlying

disease was not severe or because it was in fact severe but the treatment offered was sufficiently effective to control the symptoms adequately. It is thus important to distinguish between the concept of asthma control and that of asthma severity, the former being more relevant from a management point of view. The American Thoracic Society has recently proposed operational definitions of these two aspects, which clarify this distinction well⁶⁹. Asthma control is defined as '*the extent to which the various manifestations of asthma have been reduced or removed by treatment*' and asthma severity as '*the difficulty in controlling asthma with treatment*'. Severity can thus be considered as the therapeutic pressure required to obtain and maintain satisfactory asthma control. From a treatment perspective, it is important to ascertain the degree of asthma control since the recommended management of asthma involves a 'treat to target' approach in which the intensity of treatment is adjusted to achieve and then maintain optimal asthma control.

In the AIR studies, different approaches to the measure of asthma control have been adopted. The most simple, used for example in the AMOA study in Australia, was to ask participants how well they thought that their asthma had been controlled, without specifying what was meant by 'control'. In most of the studies, a composite measure of control was generated from answers to explicit questions on the five symptom-related criteria for control proposed by GINA, originally put forward in the first set of guidelines issued in 1995, and retained and refined in subsequent versions of these guidelines. The sixth criterion, relating to pulmonary function, cannot be assessed by telephone interview. These five criteria are the absence of daytime symptoms (no more than twice a week), the absence of night-time symptoms, no limitations in activities, no need for rescue medication (no more than twice a week) and no exacerbations. The third, and most sophisticated, approach was to use a validated specific patient-reported outcome measure to estimate control. This was the approach adopted in the AIRET⁷⁰ AIRSA²⁴ and AIRGNE²³ studies in the Middle-East. All three methods were applied in the AIRMAG study.

For those studies that assessed control through questions related to the GINA criteria, the response rates for each question obtained in the different surveys are presented in Table 3. In general, asthma control appeared to be better in the USA, Japan and Western Europe than in the countries covered by the others surveys. In particular, performance on the items related to lung function testing was worst in the AIRMAG survey. The AIRSA survey reported the highest rate of emergency department visits (Fig. 2) and the highest proportion of subjects with daytime and nighttime symptoms. The proportion of AIRMAG respondents who fulfilled all the GINA control criteria was very low, 7.6%. This is consistent with similarly poor overall control rates described in other AIR surveys, for example 5.3% in AIRE, 2.4% in AIRLA and 1.25% in AIRET.

For the studies using a specific patient-reported outcome measure (AIRET, AIRGNE, AIRSA and AIRMAG), the Asthma Control Test (ACT) was used. For this instrument, a score of 20 or more corresponds to well-controlled asthma. Using the ACT, the level of control observed in the AIRMAG study, in which 28.7% scored at least twenty on this scale appeared somewhat better than that reported previously in Turkey

Table 2. Asthma severity classification in different AIR surveys^a

Survey	Intermittent	Persistent		
		Mild	Moderate	Severe
Asthma in America ^{14,15}	43%	16%	22%	19%
AIRE ¹⁷	44%	19%	19%	18%
AIRIAP ¹⁸	53%	20%	16%	11%
AIRJ ⁶⁸	54%	12%	19%	15%
AIRCEE ¹⁹	22%	19%	27%	32%
AIRLA ²⁰	47%	22%	10%	22%
AIRMAG				
Adults	23.5%	24.8%	17.3%	34.5%
Children	30.9%	27.6%	18.7%	22.8%

^a Asthma severity was calculated using the same GINA-based algorithm in all surveys¹⁹. Data from surveys other than AIRMAG are taken from Rabe et al., 2004¹⁹.

Table 3. Asthma control estimated from replies to questions related to the GINA control criteria in different AIR studies^a

GINA guideline goal AIR survey item	AIA 1998	AIRE 1999	AIRIAP 2000	AIRJ 2000	AIRCEE 2001	AIRSA 2008	AIRGNE 2008	AIRMAG 2008
Minimal chronic symptoms								
Daytime symptoms in last four weeks	61%	56%	51%	51%	74%	75%	68%	70.1%
Night-time awakenings in last four weeks	41%	36%	44%	41%	59%	69%	51%	67.8%
Sleep disruption more than once a week	30%	30%	28%	20%	51%	42%	42%	47.4%
Minimal exacerbations								
Hospital admission in last year	9%	7%	15%	10%	19.1%	24%	23%	12.1%
Emergency department visit in last year	23%	10%	19%	13%	20.7%	70%	52%	26.9%
Minimal need for SABA								
Current use of bronchodilator	61%	63%	56.3%	39%	54.3%	82%	56%	59.7%
No limitation on physical activity								
Asthma restricts normal physical activity	36%	32%	45%	17%	68.2%	57%	48%	32.0%
(Near) Normal lung function								
Lung function never tested	53.2%	53.7%	60%	68%	36.2%	NA	66%	83.0%
Lung function tested in the last year	35%	33%	33%	29%	52.2%	23%	32.7%	14.0%
Owens a peak flow meter	28%	28%	7%	9%	5.6%	18%	17.1%	4.5%
Regularly uses a peak flow meter	8.4%	8%	3%	4%	2.8%	NA	NA	2.8%

^a SABA: short-acting beta agonists. The items in blue correspond to the best control performance for each item, and those in red the worst control performance. NA: data not available. The data for the AIA, AIRE, AIRIAP, AIRJ and AIRCEE surveys are taken from Rabe et al., 2004¹⁹.

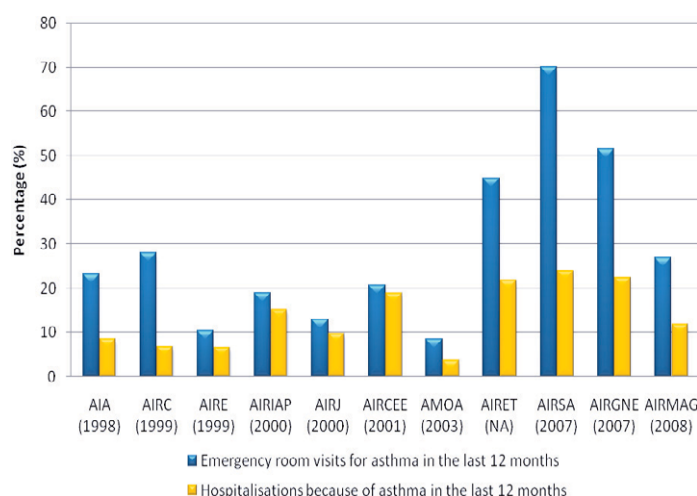


Fig. 2. Hospitalisations and emergency department visits in the different AIR studies.

(20.6%), although worse than in the AIRGNE (52%) and AIRSA (32.4%) surveys. Nonetheless asthma control as measured with the ACT, is still largely unsatisfactory in all these countries.

With respect to perceived control, less than ten percent of subjects in the AMOA study considered their asthma to be 'poorly controlled' and over fifty percent considered it 'well controlled'²¹. This optimistic vision was even shared by individuals who reported daily asthma symptoms. Comparable findings were reported from the AIRET study in Turkey²², where 45% of respondents considered their asthma to be well controlled, in spite of the fact that only 1.5% fulfilled all five GINA control criteria. Similarly, in Canada (AIRC study), 49% of subjects considered themselves to be very well controlled and 42% considered it adequately controlled¹⁶. In the AIRMAG study, 31.0% considered their asthma to be uncontrolled and although 71.3% were classified as uncontrolled using the ACT. These findings all suggest that patient perceptions of asthma control do not match the

strict definition of control set out in the GINA recommendations, or that expectations or knowledge of the potential benefits of treatment are low. Indeed, a dedicated study on perceptions of asthma control performed in general practice in France (ER'Asthme)^{71,72} has revealed that patients with asthma systematically over-estimate the quality of their asthma control compared to their family physicians. In this study, only 8% of adult patients considered their asthma control to be poor, whereas their physicians considered control to be unacceptable in 72% of patients⁷¹.

Several large clinical studies, notably the GOAL study⁷³, have shown that using recommended asthma treatments, namely inhaled corticosteroids (ICS) in monotherapy or in combination with long-acting beta-agonists (LABA), in a dynamic 'treat to target' therapy regimen can achieve asthma control in many patients, although it should be recognised that these studies generally excluded the most severe patients.

Table 4. Perceptions about asthma and its treatment in the AIRMAG sample (adults with asthma)

	Algeria (N = 154)	Morocco (N = 236)	Tunisia (N = 234)	Total (N = 624)
Aware that asthma is caused by inflammation of the airways	14 (9.8%)	59 (26.1%)	31 (14.0%)	104 (17.6%)
Considers asthma to be a psychological problem	117 (76.9%)	131 (56.9%)	148 (63.8%)	396 (64.5%)
Aware that underlying cause can be treated	29 (23.0%)	59 (35.5%)	62 (32.6%)	150 (31.1%)
Aware of treatment guidelines	18 (12.7%)	54 (23.8%)	26 (11.9%)	98 (16.7%)
Knows about ICS	42 (29.4%)	87 (39.4%)	45 (20.6%)	174 (29.9%)
Considers that it is possible to live normally with asthma	125 (82.3%)	1645 (71.6%)	148 (63.8%)	437 (71.3%)
Resigned about living with asthma	105 (68.6%)	168 (72.7%)	170 (72.9%)	443 (71.8%)
Considers that asthma restricts activities	134 (87.0%)	162 (70.2%)	172 (73.9%)	468 (75.8%)
Has difficulty accepting their disease	75 (49.4%)	115 (50.0%)	114 (48.9%)	304 (49.4%)

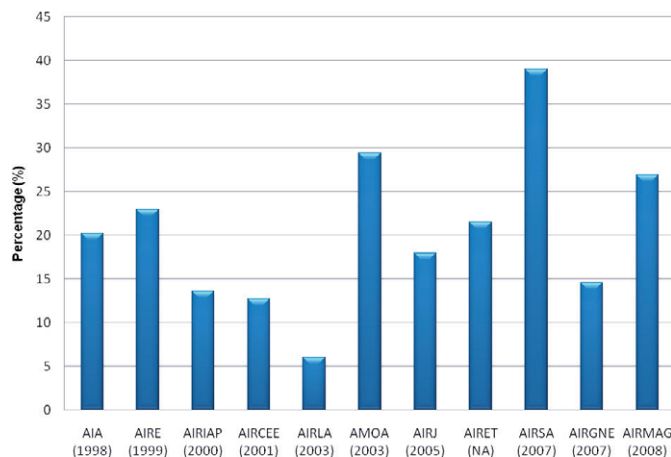


Fig. 3. Reported inhaled corticosteroid use in the different AIR surveys.

However, it is clear from the AIRMAG study, as was the case in previous AIR studies, that most individuals with asthma are not informed on what can be achieved with adequate treatment and, as a result, have low expectations of treatments and are prepared to accept a sub-optimal quality of life (Table 4). Less than one respondent in five was aware that asthma was caused by inflammation of the airways, and around two-thirds considered that it was a psychological problem. Less than a third were aware that the underlying disease process could be treated or had heard of ICS. An even lower proportion of respondents were aware of treatment guidelines. Although three-quarters thought that it was possible to live normally with asthma, a similar proportion considered that their asthma restricted their activities and claimed to be resigned to living with their asthma, which implies that they have a different perspective on what 'living normally' means to people without asthma.

Better education of patients with asthma on what can be expected from treatment in terms of reduction in symptoms and quality of life is clearly needed. If patients understood clearly that their treatment could be adjusted if adequate symptom control is not achieved, then they would be more likely to consult their physician in such cases, rather than waiting for a serious exacerbation to occur before they call a doctor or get taken to hospital, which is what happens at the moment.

Asthma treatment

Concerning treatment, 26.1% of adults and 29.1% of children in the AIRMAG study were receiving ICS, either alone or in combination with LABA. Compared to the previous AIR

studies, these treatment rates are rather high (Fig. 3). In previous AIR surveys, the highest rate of ICS use was 39%, reported in the AIRSA study in Saudi Arabia performed in 2007²⁴. It should however be borne in mind that the earliest AIR surveys were performed a decade previously to AIRMAG, and it is legitimate to believe that ICS use would have increased across the intervening period. Indeed, between the two AIRJ surveys conducted in Japan in 2000 and 2005, ICS use in adults increased by fifty percent (from 12% to 18%). Similarly, in a survey of children consulting for asthma in France performed in 2005 (ELIOS study⁷²), 71.2% were receiving an ICS. This is fourfold higher than the rate of use reported in French children in the AIRE study performed in 1999 (19.6%).

Nonetheless, no information was available in any of the AIR studies on the dose of ICS used, so it is impossible to know whether these were appropriate to obtain and maintain a good control. Systematic under-dosing of ICS has been reported previously in a survey of several developing countries, including Algeria⁷⁴. Another issue concerns persistence with ICS treatment. Although nine out of ten respondents reported using ICS at least once a day to prevent asthma symptoms, it is likely that 'drug holidays' or treatment lapses during periods of good asthma control were not infrequent. Indeed, prescription claims data collected in North America^{75–81} and Europe^{82–84} indicate that prescriptions for ICS are frequently not refilled, that compliance to treatment is poor and that use of medication is irregular. In France, less than one-third of new ICS users receive more than one repeat prescription⁸³, and one-year treatment persistence rates are lower than ten percent in

Table 5. Reasons given for non-adherence to asthma treatments in adults of the AIRMAG population

	Algeria (N = 154)	Morocco (N = 236)	Tunisia (N = 234)	Total (N = 624)
Lack of understanding of the importance of treatment	105 (77.2%)	178 (84.0%)	144 (66.4%)	427 (75.6%)
Cost of treatment too high	111 (82.8%)	175 (82.9%)	148 (67.9%)	434 (77.1%)
Absence of symptoms	86 (65.2%)	130 (62.2%)	122 (56.0%)	338 (60.5%)
Concerns about long-term medication use	84 (66.7%)	127 (62.6%)	118 (54.6%)	329 (60.4%)
Concerns about side-effects	84 (65.6%)	125 (61.0%)	105 (48.4%)	314 (57.1%)
Belief that treatment efficacy is lost over time	85 (66.4%)	123 (59.7%)	120 (55.0%)	328 (59.4%)
Absence of immediate effect of medication	81 (63.3%)	120 (58.8%)	112 (51.4%)	313 (56.9%)

Table 6. Management plan for asthma proposed by the Global Initiative for Asthma (GINA)⁸⁷

Six-Point Management Plan for asthma (GINA)	
1.	Educate patients to develop a partnership in asthma management
2.	Assess and monitor asthma severity with symptom reports and measures of lung function as much as possible
3.	Avoid exposure to risk factors
4.	Establish medication plans for chronic management in children and adults
5.	Establish individual plans for managing exacerbations
6.	Provide regular follow-up care

both France and North America^{77,80,83}. Poor adherence to asthma controller medication has been shown to be associated with loss of control and poor disease outcome^{81,85}.

Moreover, in the AIRMAG study (in which adherence was not determined), a majority of adults with asthma interviewed reported that cost of medication, resolution of symptoms, concerns about long term treatment and lack of understanding of treatment goals were important factors in non-adherence to treatment (Table 5).

Access to medication is clearly an issue in developing countries⁸⁶, such as the Maghreb, although as we have seen, reported use of ICS in the AIRMAG survey does not compare particularly unfavourably with other regions of the world, and is indeed higher than reported treatment rates in other developing countries in Asia and Latin America. In the World Health Organization classification of access to essential drugs, Algeria and Tunisia are considered to provide access for 81–95% of their population and Morocco access for 50–80%¹, although it should be noted that ICS use in the AIRMAG survey was actually higher in Morocco than in the other two countries. Apart from intrinsic drug costs, insurance reimbursement, insurance coverage, the presence of ICS on lists of essential drugs in national pharmacies, public health priorities, distribution infrastructure, the availability of generics, and the relative weights of the private and public healthcare sectors are all factors that influence access to optimal asthma care^{1,86}.

Asthma management

The 2002 GINA guidelines⁸⁷ proposed a six-point plan to improve the management of asthma (Table 6). In the 2008 revision⁸⁸, the number of points was consolidated to four, but the basic principles remain unchanged. The first point relates to patient education, and as we have seen above, there is a clear need for better information to be provided to patients with asthma in the Maghreb, in order to improve the accuracy of their perceptions of their disease and its treatment, to make their treatment expectations more realistic, to help them understand the importance of treatment adherence and to empower them to take an active part in the management of their asthma. Most of the

individuals with asthma who took part in the AIRMAG study (540/624; 93.6%) considered that being better educated about asthma was very important for them, which suggests that a patient-directed information campaign could be effective.

With regard to risk factors, active or passive smoking is the only one that has been investigated in the AIRMAG survey. Although rates of active smoking are relatively low (4% in Algeria and Morocco, and 12% in Tunisia) compared to the general population in these countries, and also compared to Europeans with asthma identified in the AIRE study ten years previously, of whom 17.5% were active smokers¹⁷. On the other hand, passive exposure to tobacco smoke was very common in AIRMAG respondents, particularly in Tunisia where over half of adults and children with asthma had at least one smoker in the family, compared with a proportion of smokers in the general population of 34.8%⁸⁹. Public health campaigns emphasising the harmfulness of smoking for other members of the household should be considered in the Maghreb.

The other elements of the GINA management plan relate to proactive follow-up of asthma control. For all of these points, care standards as reported in the AIRMAG survey leave much to be desired (Table 7). Follow-up consultations were only programmed for one-third of adults with asthma. Only one in five received a written asthma management plan, one in six had undergone a lung function test, one in ten received a standardised asthma evaluation and only in twenty possessed a peak flow meter for use at home. It is very important that physicians should recognise the necessity of programming regular follow-up visits at which asthma control should be evaluated systematically and lung function measured periodically.

For all these points, physician education programmes could be designed by asthma specialists in the Maghreb with the goal of making physicians aware of the fundamental importance of monitoring the asthma of their patients systematically and adapting their controller treatment according to the evolution of symptoms. Such a relatively inexpensive measure could have a profound impact on achieving better asthma control.

Table 7. Management of asthma in adults with asthma in the AIRMAG survey

	Algeria (N = 154)	Morocco (N = 236)	Tunisia (N = 234)	Total (N = 624)
Lung function testing	33 (23.1%)	29 (13.1%)	36 (15.9%)	98 (16.6%)
Peak flow meter use				
During consultations	36 (25.0%)	103 (46.4%)	54 (23.6%)	193 (32.4%)
At home	2 (5.4%)	2 (2.2%)	5 (7.0%)	9 (4.5%)
Drafting of an action plan	25 (17.6%)	37 (16.7%)	52 (22.9%)	114 (19.3%)
Standardised evaluation form	14 (9.7%)	22 (9.9%)	20 (8.8%)	56 (9.4%)
Programmed follow-up visits	48 (34.8%)	75 (35.2%)	85 (37.8%)	208 (36.1%)

Treatment rates, both for asthma controller medication (26%) and for relief medication for the management of exacerbations (57%), were low, and illustrate the barriers to access to optimal care that exist throughout the developing world^{86,90}. As pointed out by the GINA 'Burden of asthma' report¹, extrapolation of models of, and strategies for, healthcare provision from industrialised countries to the developing world may be very misleading. In this respect, studies such as AIRMAG play an important role in generating reliable data on asthma and its management in participating countries, which can be used to plan national asthma policies that are appropriate and adapted for the Maghreb.

Conclusions

In conclusion, the picture of asthma revealed by the AIRMAG survey reveals a moderate prevalence of asthma in the Maghreb countries. The reason why asthma prevalence is lower than in Western Europe may relate to dietary habits, contact with animals or infection with *Mycobacterium tuberculosis*. However, since North African society is becoming increasingly 'westernised', it is possible that exposure to risk factors and protective factors may be shifting in response to changes in lifestyle and living standards. For this reason, it would be most interesting to reiterate the AIRMAG study in five or ten years in order to track such developments, and possibly link any changes seen with identified environmental factors.

As observed in other developing regions of the world, the burden of asthma is relatively high and levels of control inadequate. The relatively poor asthma control observed in the Maghreb compared to other regions of the world seems to be explained not so much by insufficient access to controller treatments (although this could certainly be improved), but by the fact that asthma symptoms and treatments are not monitored systematically. Education measures directed at the patient, to improve patient understanding of disease and treatment, to reset appropriate patient expectations and to involve patients actively in the management of their asthma, together with programmes directed at the physician to ensure systematic monitoring and the use of a 'treat to target' approach to therapy, as recommended in the GINA guidelines, could do much to increase quality of life and minimise restrictions on activities in patients with asthma in the Maghreb.

Conflicts of interest

AB has nothing to declare. AD is a director of Foxymed, a medical communication and consultancy company who

participated in the exploitation of the results of the AIRMAG study on behalf of GlaxoSmithKline Laboratories, who funded the AIR research programme and market a number of treatments for asthma. PG is a member of the Respiratory Diseases Scientific Advisory Board of GlaxoSmithKline Laboratories.

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